"EMBEDDED-TYPE REFLECTIVE ROAD MARKER"

BACKGROUND TO THE INVENTION

THIS invention relates to an embedded-type reflective road marker.

In general there are two distinct types of reflective road marker, both of which are used to mark relevant features on a road surface, typically the centre line and shoulder lines. Surface mounted reflective road markers have a generally flat base which can be fixed to the road surface, normally by means of a suitable adhesive. Such road markers, which are generally cheaper to manufacture and install, are frequently dislodged from the road surface as a result of impacts from the tyres of passing vehicle. Embedded-type road markers are partially embedded in the road surface and are accordingly less susceptible to dislodgement. The present invention is particularly concerned with the latter of type of road marker.

A currently popular embedded-type road marker, manufactured and supplied by Pilkington Glass and/or Holophane under the name Armourstud™ has an upper shell of moulded glass. In combination with a base structure, the shell forms a hollow chamber in which a separately manufactured support structure is mounted. In use, a lower part of the shell and the base structure are recessed and fixed in a hole cut for the purpose in the road surface, thereby anchoring the marker. The support structure carries one or more reflectors. In operation at least a portion of the light cast onto the marker by the headlights of an approaching vehicle is reflected back to the eyes of the driver of the vehicle, the light passing through the glass shell both on entry into and exit from the marker.

The glass shell is expensive and difficult to manufacture. Including the shell, the base, necessary sealing components to seal the shell to the base and internal support and reflector components, the marker consists of a

large number of parts which require time, expertise and expense to assemble properly.

Another problem with the known markers of this type results from the desirability of providing different reflected light colours for markers which are to designate different road features. For instance, normal practice is that a centre line marker should reflect white or red light depending on whether the centre line is a broken line, implying that overtaking is permitted, or is solid, implying that overtaking is prohibited, and that a shoulder lane marker should reflect yellow or amber light. Where overtaking is permitted in one direction but prohibited in the other, opposite, direction, a marker should ideally have the ability to reflect white in one direction but red in the other.

In practice attempts to incorporate appropriate pigments in the glass shell of the known markers, so that the reflected light is has the correct colour, have been unsuccessful. This is primarily because there is no readily available pigment which is compatible with the glass moulding process and which will be resistant to the ultraviolet light that the marker will be subjected to in use. The use of differently coloured reflectors internally in the marker has also proved to be unsuccessful.

Yet another problem with the known glass-type reflector is its smooth, circular shape as a result of which it is difficult to secure the embedded reflector against rotation and/or vertical extraction from the road surface.

SUMMARY OF THE INVENTION

According to the invention there is provided an embedded-type reflective road marker comprising a generally convex shell and a base mateable with a lower edge of the shell to define, in combination with the shell, an internal chamber, the shell being of moulded plastics material and including at least

one moulded plastics reflector, forming an integral part of the shell, to reflect light cast onto the marker in use.

According to preferred features of the invention the shell has an operatively lower edge which includes a plurality of circumferentially spaced, externally projecting ribs to fix the marker against rotation when embedded in a road surface in use and which also carries an outwardly projecting flange to fix the embedded marker against being pulled out of the road surface.

In the preferred embodiment the shell has a raised, central rib and a pair of oppositely inclined, externally planar surfaces extending downwardly from the central rib in a direction towards the lower edge, such that the shell has, externally, substantially a gable shape in a cross-section transverse to the rib. Typically the shell incorporates two reflectors facing in generally opposite directions, the surfaces of the reflectors forming the externally planar surfaces of the shell.

In one embodiment the or each reflector is moulded in one piece with the remainder of the shell so as to form an integral part of the shell. In this case the shell may be made of a light transmitting material which may have the same colour, or be clear or translucent, throughout. Alternatively, different portions of the shell may be of different colour.

In another embodiment, the or each reflector is a premoulded component and the remainder of the reflector is moulded about the reflector so that the reflector forms an integral part of the shell. In this case the remainder of the shell is opaque.

In all cases it is preferred that the base is of moulded plastics construction and is ultrasonically welded to the shell. The base may carry an upstanding support wall which underlies a central, raised rib of the shell to limit downward deflection of the rib in response to vertical loads applied to the shell in use.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows an exploded perspective view of a road marker according to a first embodiment of this invention;

Figure 2 shows a side view of the assembled marker of Figure 1;

Figure 3 shows a side view of the assembled marker in the direction of the arrow 3 in Figure 2;

Figure 4 shows a plan view on the marker of Figure 2;

Figure 5 shows a cross-section at the line 5-5 in Figure 4;

Figure 6 shows a cross-section at the line 6-6 in Figure 4 and illustrates the marker of Figure 2 in an installed condition;

Figure 7 shows an underplan view of the shell of the marker of Figure 2;

Figure 8 shows a plan view on the base of the marker of Figure 2;

Figure 9 shows a plan view of a road marker according to another embodiment of the invention;

Figure 10 shows a cross-section at the line 10-10 in Figure 9;

Figure 11 shows a cross-section at the line 11-11 in Figure 9;

Figure 12 shows a perspective view of a reflector which forms an integral part of the shell of the marker of Figure 9;

Figure 13 shows a perspective view of the base of the marker of Figure 9;

Figure 14 shows a side view, in the direction of the arrow 14 in Figure 13, of the base;

Figure 15 shows a side view, in the direction of the arrow 15 in Figure 13, of the base;

Figure 16 shows a plan view of the base seen in Figure 13; and

Figure 17 shows a partial cross-section, corresponding to that of Figure 11, of a modified version of the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Figure 1 illustrates a road marker 10 according to a first embodiment of this invention in an exploded perspective view. The marker 10 has two components, namely a generally convex shell 12 and a disc-shaped base 14. The shell 12 is injection moulded in one piece of a suitably hard and tough plastics material. A preferred material is an acrylic, possibly that marketed under the name OROGLASS® by Atofina of Italy. The base 14 is injection moulded in one piece, typically of a polycarbonate, but it may alternatively be of the same plastics material as the shell 12.

With reference to Figures 1 to 7, the shell is of generally circular shape in plan and has a raised, central rib 16 extending diametrically. The rib terminates laterally at vertical shoulders 18 and longitudinally it merges into end structures 20 that extending circularly. Externally planar walls 22 extend, at opposite inclinations, downwardly from the lower edges of the shoulders 18 to horizontal walls 24. The walls 24 extending outwardly to meet, at shoulders 26, the upper edge of a generally conical wall portion

28. The latter wall portion merges with a round cylindrical side wall portion 30 that extends downwardly to a peripheral, laterally projecting flange 32 of circular shape.

The circularly extending end structures 20 also merge downwardly, at diametrically opposed positions, into the conical wall portion 28. The structures 20 define upstanding ridges that extend circularly along the side edges of the walls 22.

External, circumferentially spaced, gusset-like projections or ribs 34 extend integrally, in radial directions, between the cylindrical wall portion 30 and the flange 32.

Extending transversely across the underside of the central rib 16 is a further series of internal, spaced apart projections or ribs 35 which serve to reinforce the rib.

Internally, the lower edge of the cylindrical wall portion 30 has a stepped profile as will be particularly apparent from Figures 5 and 6.

The internal surfaces of the walls 22 are formed, during the moulding process, to have non-planar surfaces shaped to act as reflectors 36. In this embodiment, the internal surfaces are moulded as corner cube prism reflectors. Reflectors of this kind will be well known to persons skilled in the art of optical reflectors.

Overall, the shell 12 has a robust, generally convex shape as mentioned above. When viewed in a central cross-section transverse to the rib 16, the shell has, externally, an approximately gable shape, defined largely by the rib 16 and the walls 22, as will be particularly apparent from Figure 6.

The base 14 has a circular shape. Its bottom surface 40 is flat while its upper surface 42 is formed to a waffle-like configuration with an array of mutually orthogonal, upstanding ribs 44 forming a multiplicity of square

recesses therebetween. The periphery of the base is formed with a stepped profile matching the internal profile at the lower edge of the side wall portion 30 of the shell 12.

The marker 10 is assembled by fitting the base 14 into the lower edge of the shell 12 and fixing it there by ultrasonic welding to form a sealed internal chamber 50. The assembled marker is then located in a hole 52 cut in a road surface 54 (Figure 6) and is anchored there by an appropriate adhesive 56 which partially embeds the marker in the road surface.

The marker is oriented such that the rib 16 is transverse to the direction in which vehicles travel on the road, i.e. transverse to the line which is being marked. The embedded, projecting ribs 34 prevent the marker from rotating out of this orientation. At the same time, the inclination of the outer surfaces of the ribs also prevents the marker from being pulled upwardly out of the road surface.

On a road where vehicles are travelling simultaneously in opposite directions, separated from one another by a centre line on which markers 10 have been installed, the walls 22 face in opposite directions towards the oncoming traffic. Light cast by the headlights of a vehicle will pass through the relevant wall 22 and will be reflected back through that wall, by the associated reflector 36, such that a portion of the reflected light will travel to the eyes of the driver of the vehicle. The position of the centre line will accordingly be readily apparent to the driver.

It will be understood that the reflectors 36 are designed to reflect light, cast on the marker over the applicable range of angles, back through an appropriate range of angles, such that a meaningful amount of light reaches the driver's eyes.

Assuming that the plastics material of which the shell is moulded is consistent throughout, it will also be understood that the refractive index of such material, the thickness of the walls 22, the specific design of the

reflector and so on will all be carefully chosen to ensure adequate light reflection through an appropriate range of angles.

In cases where the marker is installed in a road surface where it is only necessary to reflect light in one direction, as opposed to opposite directions, a reflector may be provided for one of the walls 22 only. This could, for instance, be the case for a marker used to indicate a line marking the shoulder or run-off lane of a road.

For white light reflection, the shell 12 may be moulded in a colourless, typically clear material. However where the marker 10 is to be positioned to reflect another light colour, such as red or yellow, it is possible to incorporate an appropriate pigmentation or colouration in the plastic material during moulding. Where a single shot injection mould is used, this will result in a shell 12 which is consistently of the chosen colour.

In some cases, it is desirable for a single marker to reflect different light colours in opposite directions. This may for instance be the case where the marker is installed on a centre line and is required to reflect red light in one direction to indicate to drivers approaching from that direction that overtaking is prohibited, and white light in the opposite direction to indicate to drivers approaching from that direction that overtaking is permitted. To achieve this it is possible to mould the shell 12 in one piece using a two-shot mould in which the plastics material is introduced simultaneously from opposite sides of the central rib 16.

The plastics material introduced from the opposite sides may then have different pigmentation or colouration, resulting in a shell 12 which has different colours on opposite sides of a central vertical plane, indicated by the numeral 60 in Figure 2.

The marker 10 has a number of advantages compared to the previously described Armourstud™ marker of the prior art. These advantages include the fact that the marker has only two components, namely the shell and the

base, whereas the Armourstud™ marker has multiple components. Injection moulding of the plastics components and subsequent assembly thereof to form the complete marker will, it is believed, be simple and economical.

Another advantage arises from the fact that it is possible to provide reliable colouration of the marker for different applications. Still further, as described above, the shell can be moulded in two colours, enabling the marker to reflect light of different colour in opposite directions.

Another important advantage of the illustrated embodiment is the fact that a substantial free volume remains in the marker after assembly. This provides space to accommodate additional safety equipment in the marker. Such equipment may, for instance, include light sources, such as LEDs (light emitting diodes), solar panels to produce energy to power the light sources, sensors for detecting wet conditions, black ice conditions or conditions of darkness and so on. Such equipment could, for instance, be the same as or similar to road marker equipment supplied by Astucia Traffic Management Systems of the United Kingdom in its SolarLite range of products. With such added features, the marker 10 can enhance the safety of road users. The incorporation of such features is not possible with the Armourstud™ marker in view of the considerable space taken up by the reflector support structure which is centrally located in the chamber.

As indicated previously, it is possible in other embodiments of the invention for the reflector 36 to be a separately moulded item which is then fixed in position, internally against the wall 22, before the base is connected to the shell. Although this proposal will add an additional assembly step in the manufacture of the marker 10, it has the advantage that plastics material of different refractive index or quality can be used for the shell and for the reflector respectively. It also makes it possible to use clear or colourless plastic for the shell and to incorporate reflectors of different colour.

Figures 9 to 16 illustrate a road marker according to a second embodiment of the invention. This embodiment has many similarities to the first embodiment described above and like components are designated with like reference numerals.

The overall shell 12 of the second embodiment has a shape which is almost identical to that of the shell of the first embodiment. However, whereas the reflector 36 of the second embodiment is moulded in one piece, at the same time as the remainder of the shell 12, the reflector 36 of the second embodiment is a premoulded component. The premoulded reflector 36, seen in Figure 12, is of a plastics material, preferably an acrylic, which is identical to that of the remainder of the shell. It has a planar front surface 36.1, a rear surface 36.2 formed as a corner cube prism reflector and a lip 36.3 bounding the rear surface.

During the injection moulding of the remainder of the shell, the premoulded reflector 36 is placed on a suitable core in the mould, prior to introduction of the plastics material which is to form the remainder of the shell, in such a way that the planar front surface 36.1 of the reflector will form the outer surface 22 of the moulded product. The plastics material is then injected into the mould and comes into contact with the side edges only of the premoulded reflector. A degree of fusion takes place, under the applied temperature and pressure, between the newly injected plastics material and the plastics material of the reflector. An integral and sealed connection is accordingly obtained between the remainder of the shell and the reflector itself, as indicated by the numeral 100 in the enlarged portion of Figure 10, with the reflector forming an integral part of the shell.

It will be understood that where the marker is to reflect light in opposite directions, two reflectors are moulded into the plastics of the shell simultaneously.

With the technique just described, it is possible to use differently coloured reflectors 36 to reflect light of different colour in opposite directions.

Because the planar surface 36.1 of the reflector forms the external, planar surface 22 of the shell, it is also possible to use plastics material for the shell which is opaque to the incident light. Because the shell material does not itself have to transmit light, it is also possible to reinforce this material, for instance with glass fibres, thereby improving the overall robustness of the final product.

In another, less preferred alternative using premoulded reflectors, the reflectors could be overmoulded, i.e. held in the mould in such a manner that the planar surface 36.1 of the reflector is embedded within the injected plastics material. The reflectors again form an integral part of the shell but in this situation, a skin of material will overly the surface 36.1. This means that in this version of the invention the plastics material which is injection moulded to form the remainder of the shell must be light-transmitting.

The base 14 seen in Figures 10, 11 and 13 to 16 differs from the base 14 of the first embodiment only in that it includes an upstanding support wall 102 which is moulded in one piece with the remainder of the base. The wall is reinforced by laterally projecting gussets 104.

Referring in particular to Figure 10, it will be seen that when the base 14 is fitted to the lower edge of the shell 12, the upper edge 106 of the wall 102 lies just beneath a rib 103 extending longitudinally as the lower extremity of the rib 16 of the shell. In this regard it will also be noted that the rib 16 does not have the localised projections 35 of the first embodiment.

The support wall 102 serves to limit the deflection which the rib 16 can undergo when a particularly heavy load is applied to it by, for example, passage over the marker of the tyre of a very heavy vehicle. This may for example happen in situations where the marker is used to mark the shoulder line of a road over which heavy vehicles frequently stray. By limiting the deflection which the rib 16 can undergo it is anticipated that it will be possible to prolong the life of the marker 10.

The invention envisages other methods to strengthen the shell by limiting the deflection undergone by the central rib 16. The rib could for instance have a particularly robust construction at least in zones where it is subjected to the greatest bending forces, or it could be locally reinforced by formations such as the projections 35.

Although the support wall serves an important function it is recognized that it does limit the internal space in the marker for auxiliary equipment as described previously.

Figure 17 shows a partial cross-section corresponding to that of Figure 11 of a slightly modified version of the embodiment of Figures 9 to 16. As in the embodiment of Figures 9 to 16, the reflector 36 is a premoulded component which is moulded integrally into the plastics shell during moulding of the shell. It will be noted in this version that the edges of the reflector are shaped to provide a particularly robust interlock with the injected plastics material of the shell. Combined with the degree of fusion which takes place, this configuration provides for a sealed union of high integrity between the reflector and shell.

Compared to conventional moulded glass markers, another important advantage of the embodiments of the present invention described above is the fact that the shape of the shell, and particularly the provision of the flange 32 and ribs 34, promotes secure embedment of the marker in the road surface. As indicated the flange and ribs provide mechanical resistance to rotation or upward extraction of the road marker from its embedded position.

It was previously mentioned that acrylic is a preferred material for the shell of the road marker. This is particularly so in instances where the shell is to transmit light. In situations where light transmission by the shell is not required, for example in embodiments such as that described with reference to Figures 9 to 16 and 17, the shell may be moulded of a polycarbonate blend which may include a polyester for ultraviolet

resistance. The shell in such cases will be particularly strong. Where separately moulded reflectors are used, these may be of acrylic, as mentioned previously, or polycarbonate.